**3GPP TSG-RAN WG2 Meeting #115-e R2-210xxxx**

**Online, Aug 16th – 27th, 2021**

**Agenda Item: 8.19.2**

**Source: ZTE Corporation**

**Title: Summary of [AT115-e][111][CE] Msg3 repetition**

**Document for: Discussion and decision**

# Introduction

This document summarizes the following offline discussion.

* [AT115-e][111][CE] Msg3 repetition (ZTE)

Initial scope: Continue the discussion on p4-p9 from [R2-2107745](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2107745%20Consideration%20on%20Msg3%20repetition%20in%20CE.docx), p2-p7 from [R2-2107220](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2107220_RAN2%20enhancements%20for%20Msg3%20repetition.docx), p3 from [R2-2107008](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2107008_MAC%20Aspects%20of%20UL%20Coverage%20Enhancements.doc) and p1-p3 from [R2-2108003](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2108003.docx)

Intended outcome: Summary of the offline discussion with e.g.:

* + - List of proposals for agreement (if any)
		- List of proposals that require online discussions
		- List of proposals that should not be pursued (if any)

Initial deadline (for companies' feedback): Monday 2021-08-23 10:00 UTC

Initial deadline (for rapporteur's summary in R2-2108895): Monday 2021-08-23 16:00 UTC

Proposals marked "for agreement" in R2-2108895 not challenged until Tuesday 2021-08-24 0800 UTC will be declared as agreed via email by the session chair (for the rest the discussion will further continue online).

# Contact from companies

|  |  |
| --- | --- |
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# Background

Following agreements were reached after first (Wednesday) online discussion:

Agreements:

1. RAN2 should focus on Msg3 repetition for 4-step RACH, unless RAN1 makes solid conclusion to support Msg3 repetition for fallbackRAR
2. Agreed. Msg3 repetition is applicable to all cases that trigger 4-step CBRA procedure (can come back if we identify that some specific case should not be covered)
3. A separate RSRP threshold is introduced for requesting Msg3 repetition.

# Discussion

## Msg3 repetition on NUL/SUL

A NR cell can be configured with both NUL carrier and SUL carrier, so far, RAN1 hasn’t discussed whether Msg3 repetition can be configured on SUL carrier. In [3], it lists the following 4 scenarios:

* **Scenario 1: Cell is configured with only NUL, and Msg3 repetition is enabled;**
* **Scenario 2: Cell is configured with both NUL and SUL, and Msg3 repetition is only configured on NUL;**
* **Scenario 3: Cell is configured with both NUL and SUL, and Msg3 repetition is only configured on SUL;**
* **Scenario 4: Cell is configured with both NUL and SUL, and Msg3 repetition is configured on both NUL and SUL.**

For flexibility, it is proposed to confirm all above scenarios can be supported in Rel-17. So Msg3 repetition function can be enabled on either NUL or SUL, or both.

Companies are invited to show your views on this.

**Q1. From RAN2 perspective, do companies agree Msg3 repetition can be configured on either NUL or SUL, or both?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Lenovo | Yes |  |
| Qualcomm | Yes | It can be left to network configuration. We don’t see use cases to exclude any one of the above configuration scenarios. |
| Ericsson | NA | RAN1 did not discuss SUL at all. While we are neutral, I think it would make sense to check with RAN1. |
| ZTE | Yes | We expect the network implementation to be flexible enough. But we are also fine if companies want to check with RAN1.  |
| Samsung | See comments | Same view as Ericsson. |
| China Telecom | Yes | We see benefits for flexibility. |
| CATT | Yes | Ok to check with R1.  |
| Huawei, HiSilicon | Yes | Agree with Qualcomm. If companies have concerns on the RAN1 status, we are okay to consider it as baseline and can come back if RAN1 has different understandings. |
| OPPO |  | Agree with Ericsson to check with RAN1. |
| LG |  | Ok to check with RAN1. But, if SUL is configured, we wonder why NUL is configured with Msg3 repetition instead of using SUL for the extended coverage.  |
| Sharp | Yes | The gNB should have flexibility to configure msg3 repetition either or both NUL and SUL. |
| Intel | See comments | Agree with Ericsson. |

Summary:

12 companies provide feedback, 5 companies think we should check with RAN1 before making decision in RAN2. And 7 companies agree with the proposal where 2 of them are also fine to check with RAN1.

Based on the observation, it is true that RAN1 hasn’t discussed this before. Based on company feedback, it seems hard to make conclusion right now, so rapporteur suggests to check with RAN1 by sending LS. See rapporteur’s proposal under Q3.

According to RAN2 agreement, a separate RSRP threshold will be introduced for requesting Msg3 repetition. When measured RSRP is below the threshold, UE can request network to enable Msg3 repetition.

So if answer ‘Yes’ to Q1, the next question is whether separate RSRP thresholds are needed for requesting Msg3 repetition on NUL and SUL. Companies are invited to show your views.

**Q2. If answer ‘Yes’ to Q1, do companies agree different RSRP thresholds are needed for requesting Msg3 repetition on NUL and SUL?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Lenovo | Yes |  |
| Qualcomm | No | Whether a UE is allowed to request Msg3 repetition only needs to depend on whether its RSRP measurement is below a threshold. NUL does have long cell range, but that does not mean it can give UE extra link budget.  |
| Ericson | No | In general we should strive to reduce the amount of new RACH thresholds, but in this case it is not needed. The reason being that since SUL has its own BWP configuration that includes RACH configuration that further includes thresholds that can be configured to be different for SUL and NUL. Thus when we introduce the separate RSRP threshold for requesting msg3 repetitions in the RACH config, the same threshold could be used for SUL. |
| ZTE | Yes | To clarify the intention of this question, as also mentioned by Ericsson, the RSRP threshold for requesting Msg3 repetition will be carried in RACH config. Both NUL and SUL has its own RACH configuration, thus naturally, there will be two separate RSRP thresholds (one is included in NUL configuration, the other is included in SUL configuration). This question is to ask (in case network enables Msg3 repetition on both NUL and SUL) whether network must configure the RSRP thresholds to the same value? Or different values can be allowed?Considering NUL and SUL are operating on different frequencies, the propagation characteristics can be different, so we think the RSRP thresholds for requesting Msg3 repetition need to be different.(To avoid misunderstanding, I have changed ‘separate’ into ‘different’ in the question.) |
| Samsung | See comments | Leave it to RAN1 as threshold for Msg3 repetition is decided by RAN1 |
| China Telecom | Yes | We see benefits for the network to flexibly optimize the related resource configuration by adjusting SUL and/or NUL specific RSRP thresholds when MSG3 repetition is configured on both SUL and NUL. |
| CATT | see comments | Agree with previous comments that the question can be made clearer. But in general, for SUL aspect here we can leave this to R1 whether and how the threshold is configured. Once R1 has some input to us, we could specify the singling accordingly.  |
| Huawei, HiSilicon | See comments | We think separate configuration of the RSRP threshold for NUL and SUL can be agreeable. Whether to apply the same or different values seems like the implementation issue, and we are okay to discuss further.  |
| OPPO | See comments | This will be up to RAN1 to discuss and decide. |
| LG | See comments | In our assumption, the UE first selects NUL or SUL based on *rsrp-ThresholdSSB-SUL.* Within the selected carrier, the UE selects 2-step or 4-step RA. For the selected RA type in the selected carrier, the UE further selects an SSB based on *rsr-ThresholdSSB*. As the msg3 repetition in NUL and SUL are targeting different coverage, we think it is straightforward to have a different threshold value for Msg3 repetition in NUL and SUL. Furthermore, it is difficult to understand how the threshold for Msg3 repetition in SUL is used as the threshold for Msg3 repetition in NUL. If the UE selects SUL, it means that the RSRP is currently low and the Msg3 repetition will be useful to those who are edge of SUL coverage, i.e., when RSRP is very low. However, if the UE selects the NUL, the RSRP would be currently reasonable. So, if the msg3 repetition threshold for SUL is reused for NUL, no Msg3 repetition will happen.  |
| Sharp | Yes | Given that SUL is deployed in different band from NUL, coverage requirement would be also different. |
| Intel | See comments | We think this issue can be left to RAN1. |

Summary:

12 companies provide feedback, 2 companies think different RSRP thresholds are not needed, 4 companies think different RSRP thresholds are needed because SUL is operating on different band. While 6 companies did not provide clear preference and some of them think this should be decided by RAN1.

Similar to Q1, if LS is sent to RAN1, we can include this question as well. See rapporteur’s proposal under Q3.

Based on online discussion, some companies think we should consult RAN1 on the support of Msg3 repetition on NUL/SUL. From rapporteur’s point of view, I think this more relates to network deployment, and it has no RAN1 impact, so RAN2 should be able to make decision. But if there is strong concern, we can send LS to RAN1 for confirmation. Companies are invited to show your view on whether LS is needed.

**Q3. Do companies think RAN2 needs to ask RAN1 if they have concern on support of Msg3 repetition on NUL&SUL (e.g. sending LS)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Lenovo | Yes | We think it’s good to inform RAN1 about our agreements on NUL/SUL, so that they can raise concerns if they have any. |
| Qualcomm | No | We don’t have a strong view. But at least for now we don’t see a need to consult RAN1 on this issue. |
| Ericsson | Yes | We do not think a strong concern is needed to check in with RAN1. They are after all the leading work group and as far as we know they did not even discuss SUL, then it could be good to see why that is the case.  |
| ZTE | Yes | Although we think RAN2 can make a decision on this, we are fine to check with RAN1 if companies have concern. |
| Samsung | Yes |  |
| China Telecom | Yes |  |
| CATT | Yes |  |
| Huawei, HiSilicon | No | Agree with QC. We acknowledge that carrier selection is performed in RACH initialization and doesn’t change for every attempt, so we don’t see it has big impact on issues what we are discussing in RAN2.  |
| OPPO | Yes |  |
| LG | Yes | It would be good to consult with RAN1 on this. |
| Sharp | No | Agree with moderator’s assessment that it would have no RAN1 impact. |
| Intel | Yes |  |

Summary:

12 companies provide feedback, 9 companies agree to send LS to RAN1, 3 companies prefer no LS because carrier selection is performed in RACH initialization, and allowing Msg3 repetition on both NUL and SUL has no RAN1 impact.

Based on majority views, and take into account the feedback to Q1 and Q2, rapporteur suggests:

**Proposal 1 [9/12] Send LS to RAN1 to ask:**

* **Q1: whether Msg3 repetition can be supported on both NUL and SUL?**
* **Q2: If answer ‘Yes’ to Q1, whether different RSRP thresholds are needed for NUL and SUL?**

## Potential impact on cell selection

In [3] and [2], the impact on cell selection are discussed. In short, for UEs capable of Msg3 repetition, even if its RSRP results is lower than legacy UEs, the UE is able to RACH and get connected to the target cell, because Msg3 repetition can help make up the shortage in link budget. So the UL coverage for Msg3 capable UEs can be different from those non-Msg3 capable UEs. This is similar to SUL.

For SUL, separate cell selection/reselection threshold can be broadcasted in SIB, similarly, separate cell selection threshold (e.g. Qrxlevmin, Qqualmin) needs to be provided for UEs capable of Msg3 repetition.

Based on online discussion, one company commented this is out of scope of WID. (The objective of WID is copied/pasted below)

* **Specify mechanism(s) to support Type A PUSCH repetitions for Msg3 [RAN1, RAN2]**

From rapporteur point of view, for supporting Type A PUSCH repetition for Msg3, RAN2 is responsible to study any potential RAN2 impact, the objective does not preclude any technical point. In addition, some company commented Msg1 repetition is not supported, thus UL coverage can not be extended. But according to the study in RAN1, PRACH has better performance than PUSCH, so PRACH is not bottleneck of UL transmission. That is why Msg3 repetition is considered instead of Msg1 repetition.

Companies are invited to show your views.

**Q4. Do companies agree separate cell access thresholds (e.g. Qrxlevmin, Qqualmin) can be provided for UEs capable of Msg3 repetition?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Lenovo | No | It is our understanding that the Msg3 enhancements are targeted only for UEs in connected state. Therefore, we think that cell (re)selection should not be impacted. We should not extend the scope of the WI unnecessarily. Unclarities of the WI scope can be discussed in RAN plenary. |
| Qualcomm | Yes | UEs capable of Msg3 repetition can access a cell at lower minimum RSRP than legacy UEs. Therefore, Qrxlevmin and Qqualmin, which are the minimum Rx and quality levels allowed for a cell, should be set differently for coverage enhanced UEs.We agree with the rapporteur’s argument above that the WID does not restrict RAN2 from studying any particular upper-layer procedures impacted by msg4 repetition.  |
| Ericsson | No | We do not think that this is needed. As this is out of the scope of the WID (and not discussed during RAN1 WI or SI), this would need a strong motivation and in this case this is an enhancement rather than something that is really needed to be fixed. For LTE CE new cell reselection parameters was introduced when there were significant amount coverage extension on all channels which is not the case here. There are network implementation methods to increase coverage of msg3 through for instance more msg3 retransmissions, but this has not resulted in a new cell reselection parameters. |
| ZTE | Yes | Same view as Qualcomm, for UEs supporting Msg3 repetition, they are able to access cell with even lower RSRP compared with legacy UEs. So separate set of cell selection thresholds are needed for CE capable UEs. Response to Ericsson’s question, for SUL, there is no enhancement to downlink transmission, but separate cell selection/reselection parameters were introduced only because of uplink enhancement. For NR CE, to improve the ul coverage, Msg3 PUSCH and other PUSCH, PUCCH repetition are supported, so, the situation is similar to SUL.  |
| Samsung | No | Same view as Ericsson |
| China Telecom | Yes | Agree with Qualcomm |
| CATT | FFS | We need for time to consider this.  |
| Huawei, HiSilicon | No | Agree with Ericsson. If RAN2 agreed to support, it should be discussed and confirmed in RANP. Otherwise, we have concerned on the TU allocation.  |
| OPPO | No | Same view as Ericsson. This is not in the WID scope. RAN2 can discuss this only after RANP decides to update the WID. |
| LG | Yes | If UE camps on a cell using the legacy thresholds, this means an adequate DL/UL quality would be guaranteed between the UE and the cell, and the Msg3 doesn’t need to be repeated. If the Msg3 repetition in IDLE/INACTIVE is in scope, the separate thresholds need to be provided. |
| Sharp | FFS | We can discuss further. In our view, the issue is not out of scope of WI. |
| Intel | No | Agree with Ericsson.  |

Summary:

12 companies provide feedback, 4 companies agree separate set of minimum cell access thresholds are needed for UEs supporting Msg3 repetition. 6 companies don’t agree and 2 companies want more time to check.

**Proposal 2 [4 vs 6] (To discuss) Network can configure a separate set of minimum cell access thresholds (e.g. Qrxlevmin, Qqualmin) for Msg3 repetition capable UEs.**

## Handling of Contention Resolution Timer

In current TS 38.321, the start of contention resolution timer is described as below (for HARQ retransmission):

|  |
| --- |
| 5.1.5 Contention ResolutionOnce Msg3 is transmitted the MAC entity shall:1. start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 (re)transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap; |

Regarding Msg3 repetition, the handling of ra-ContentionResolutionTimer is discussed in several contributions, in summary, there are 3 options (companies please double check if any option is missing):

* Option 1: (Re)start *ra-ContentionResolutionTimer* in the first symbol after all Msg3 repetitions [2][4].



* Option 2: (Re)start *ra-ContentionResolutionTimer* in the first symbol after each Msg3 repetition [3].



* Option 3: Start *ra-ContentionResolutionTimer* in the first symbol after 1st Msg3 transmission, and does not restart it after follow-up Msg3 repetitions [1].



For Option 2 and Option 3, early Msg3 repetition termination can be supported. But some companies commented there is challenge for UE to monitor PDCCH before finishing all the repetitions. Although this was discussed in RAN1 before, and no onsensus was reached. From rapporteur’s point of view, this should be discussed and determined in RAN2, because it mainly impact MAC spec.

So regarding above options, companies are invited to show your views.

**Q5. Which option do companies prefer for handling *ra-ContentionResolutionTimer* in Msg3 repetition?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1/2/3** | **Comments** |
| Lenovo | Option 1 | Is a straightforward solution. |
| Qualcomm | Option 1 | For two reasons:* Msg3 repetition should leverage joint channel estimation to maximize the coverage. For joint channel estimation to work, UE needs to maintain phase continuity between repetitions. It is very challenging if UE has to switch between DL reception (monitoring PDCCH monitoring for Msg4) and UL Tx (Msg3).
* If network does its estimation right, the number of repetitions scheduled by network should be such that it can successfully decode Msg3 only after most or all repetitions are performed. Hence in most cases, monitoring PDCCH for Msg4 too early wastes UE power.

Lastly, some companies have argued that in the current MAC spec each repetition is modelled as a retransmission. We think that is only a matter of modelling for simpler spec text. We do not need to force that model into Msg3 repetition.  |
| Ericsson | Option 1 | First of all PUSCH early termination was discussed during study item phase but was not agreed and is not in the scope of PUSCH enhancements. RAN2 should thus not introduce these type of solutions. For Option 1: This is how it was introduced in LTE CE and we see no reason why we would do anything else. For Option 2: See above on PUSCH early termination. Option 3: This might be problematic with legacy, since the contention resolution timer would be the same for legacy and msg3 repetition Ues. With repetitions, the time from msg3 transmission and msg4 reception would be smaller for msg3 repetition Ues and for some values for ra-ContentionResolutionTimer the network could not schedule enough repetitions.  |
| ZTE | Option 2 | We admit PUSCH early termination has been discussed in RAN1, and no conclusion so far. We prefer Option 2 because it is possible that Gnb can decode the Msg3 repetition without waiting till last repetition. Typically the target HARQ error rate for first repetition is pretty high (e.g. 30% error rate). So there could be a very high chance that Gnb can detect it even after the first repetition, there is no need to must wait until the last repetition.  |
| Samsung | - | No strong view.  |
| China Telecom | - | We think option1 exclude PUSCH early termination, but RAN1 has no conclusion on whether to support PUSCH early termination or not. Thus we have no strong view on these options now. |
| CATT | Option 1 | Option 1 is straightforward and simple. It does not require network nor UE to check after each tx before a repetition bundle is completed. UE does not need to monitor that ‘potential’ early termination indication in L1 control as well, which saves power. Furthermore, whether early termination really helps seems to highly depend on how network configures the thresholds that control the repetition. We do not see a strong need to optimize given the rather vague benefits.  |
| Huawei, HiSilicon | - | Option 3 possibly requires to extend the CR timer given the repetition is introduced. We are not okay to accept this change. Regarding Option 1 and 2, we have slight preference on Option 2 as it gives flexibility of NW scheduling and consistent with the current MAC spec which can also simplify the UE implementation. But we are also fine to wait for RAN1 if no consensus can be achieved in RAN2. |
| OPPO | Option 3 for full-duplex UEs; option 1 for half-duplex UEs | For full-duplex UEs, we think option 3 starts the CR timer earlier and is beneficial for early PUSCH termination. For half-duplex UEs, starting CR timer earlier is not needed as UE is anyway transmitting PUSCH and cannot receive downlink in the same time, so option 1 is reasonable. |
| LG | Option 2 | Option 2 is supported without specification change because the UE currently starts/restarts for every retransmission and Msg3 is retransmitted using a HARQ. Option 3 may need more values by considering the repetition number. |
| Sharp |  | We are fine with either. |
|  Intel | Option 1 | We don’t think early termination is in the scope of the WI, therefore option 1 should be supported.  |

Summary:

12 companies provide feedback, 5 companies support Option 1; 3 companies support Option 2 (1 of them has slightly preference); 3 companies have no strong view so far. 1 company thinks we should adopt different solution for different kinds of UEs (Option 3 for full-duplex UEs, Option 1 for half-duplex UEs).

From rapporteur’s point of view, at least there is less support on Option 3. In addition, supporting Option 3 requires extending *ra-ContentionResolutionTimer* which has very less support in Q6. So rapporteur suggests to exclude Option 3 first.

Regarding Option 1 and 2, there is slightly majority prefer Option 1 (5 vs 3), so rapporteur suggests to further discuss it.

**Proposal 3 (To discuss) For starting/re-starting *ra-ContentionResolutionTimer* in Msg3 repetition, to select one of following options:**

* **Option 1[5]: (Re)start *ra-ContentionResolutionTimer* in the first symbol after all Msg3 repetitions;**
* **Option 2[3]: (Re)start *ra-ContentionResolutionTimer* in the first symbol after each Msg3 repetition.**

In [4], is also proposes to not extend ra-ResponseWindow and ra-ContentionResolutionTimer for Msg3, because PDCCH/PDSCH for Msg2/4 repetition are not supported in CE.

Proposal 3: No extension is needed for *ra-ResponseWindow* and *ra-ContentionResolutionTimer* for MSG3 repetition.

Rapporteur understand this may also relate to the discussion in Q5 (e.g. if Option 3 is adopted). Companies are invited to show your views on this.

**Q6. For MSG3 repetition, do companies agree extension of *ra-ResponseWindow* and *ra-ContentionResolutionTimer* is not needed?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Lenovo | Yes | DL coverage enhancements are not in WI scope. |
| Qualcomm | Agree | No extension is necessary. |
| Ericsson  | Yes |  |
| ZTE | Yes |  |
| Samsung | yes |  |
| China Telecom | No strong view |  |
| CATT | Yes | As proponent. For *ta-ReponseWindow*, there are no enhancements on Preamble design, so it is natually that no extension *ra-ResponseWindow.*Regarding *ra-ContentionResolutionWindow,* there is no enhancements on PDCCH/PDSCH for MSG2/4 repetition based on the previous discussions in RAN1 and there is no great complexity on decoding the all the repetitons of MSG3. Hence, we think it is not necessary to extend it either. |
| Huawei, HiSilicon | Yes | Should be avoided. |
| OPPO | Yes |  |
| LG | Yes |  |
| Shap | Yes | Agree with Lenovo. |
| Intel | Yes |  |

Summary:

12 companies provide feedback, 11 companies support the proposal and 1 company has no strong view. Based on the significant support, rapporteur suggests:

**Proposal 4 [11/12] Extension of *ra-ResponseWindow* and *ra-ContentionResolutionTimer* are not needed for Msg3 repetition.**

## Separate RA parameters for Msg3 repetition

In [2], it mentions with Msg3 repetition, Msg1 transmission may become the coverage bottleneck in RACH procedure, so to achieve full benefit of Msg3 repetition, we can consider other method to improve the performance of Msg1 transmission, i.e. through different Tx power control and more transmission opportunities, more specifically:

(copied/pasted the text/proposal from [2])

* *preambleReceivedTargetPower* is the initial Msg1 Tx power. As a UE eligible for Msg3 repetition has poorer link quality than average UEs, its Msg1 Tx should have higher initial power to increase the likelihood of success.
* Size of power ramping step depends on expected interference level. Since a UE eligible for Msg3 repetition has poorer link quality, it is more likely located near cell edge and subject to inter-cell interference. Therefore, it can benefit from larger power ramping step size when overcoming interference in its Msg1 transmission.
* *preambleTransMax* controls the maximum number of Msg1 Tx. Since a UE eligible for Msg3 repetition has poorer link quality, it makes sense for the UE to have more retransmission opportunities to ensure comparable coverage with repeated Msg3.

 Proposal 1. Msg1 transmission by UE to request Msg3 repetitions can be configured with its specific set of *preambleReceivedTargetPower*, *powerRampingStep*, *powerRampingStepHighPriority, preambleTransMax* and *groupBconfigured.*

**Q7. Do companies agree with above Proposal 1?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Lenovo | No | Msg1 enhancements were discussed during the SI phase but during scoping of the WI in RAN#90-e, no consensus could be reached to consider Msg1 enhancements in the WI. Therefore, we should not extend the scope of the WI unnecessarily. Unclarities of the WI scope can be discussed in RAN plenary. |
| Qualcomm | Yes | We are the proponent |
| Ericsson | Yes | I think we are fine with those parameters being configured except for *powerRampingStepHighPriority*. This is a part of random access prioritization parameters that I think RAN2 should discuss separately how it applies to msg3 repetitions. FFS how all of these are configured. |
| ZTE | Yes | We agree with the intention. We can further discuss the details as commented by Ericsson.  |
| Samsung | No | Msg1 enhancements is not in scope. Additionally Msg1 is Physical layer channel and if there is any issue and additional enhancements are needed, it should be discussed in RAN1. |
| China Telecom | Yes |  |
| CATT | see comments | We tend to agree that these should first be discussed in R1. |
| Huawei, HiSilicon | No | It’s not clear if Msg1 becomes the coverage bottleneck when Msg3 repetition is supported. According to the WID (RP-211566), the objective of CovEnh is to enhance PUSCH, PUCCH and Msg3 PUSCH. Since the benefit of Msg1 enhancement is unclear for now, we tend to disagree with this proposal. |
| OPPO | No | This is not in the WID’s scope. |
| LG | No | As indicated in the online discussion, this can be considered when the separate RO is support, but it is still FFS in RAN1, so RAN2 does not need to be rush for this issue and can wait for RAN1 progress. |
| Sharp | Yes | Separate target power for msg1 is at least necessary to exploit benefit of msg3 repetition. |
| Intel | No | This is not in the scope of WID. |

Summary:

12 companies provide feedback, 5 companies support the proposal, 6 companies disagree where 2 companies suggest to leave it to RAN1.

Company views are divergent. Based on the significant support, rapporteur suggests:

**Proposal 5 [5 vs 6] (To discuss) Msg1 transmission by UE to request Msg3 repetitions can be configured with its specific set of RACH parameters (e.g. preambleReceivedTargetPower, powerRampingStep, powerRampingStepHighPriority, preambleTransMax, groupBconfigured).**

## Msg3 repetition for preamble group B

In [2], it proposes to allow network to configure Msg3 repetition also for Preamble group B.

Proposal 2. Preamble group B can be jointly configured with Msg3 repetition.

Preamble group B is used to request a large UL grant for Msg3, although repetition of large Msg3 looks resource consuming, but in [2], it explains Msg3 repetition can be useful for some use case, e.g. for UEs with only small amount of data to send and can leverage RACH based SDT or when cell loading is low. And it is fully within network’s control.

Companies are invited to show your views on whether to support Msg 3 repetition for large Msg3 case.

**Q8. Do companies agree preamble group B can be jointly configured with Msg3 repetition?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Lenovo |  | We think that this should be coordinated with RAN1. We don’t know which Msg3 sizes they have considered yet in the design of Msg3 repetitions. Therefore, we suggest to add this question in the LS to RAN1. |
| Qualcomm | Yes | We think that in some cases group B can be useful even when UE needs support of coverage enhancement. One example is RA-SDT for sensors (RedCap), which typically have tight link budget and are power sensitive. When network configures dedicated PRACH resources for those Ues, joint configuration between group B and Msg3 repetition hence is very useful. What we are proposing is that we do not need to explicitly prohibit network from joint configuration between group B and Msg3 repetition. That decision can be left to network. |
| Ericsson | Yes | Sure, this could be beneficial for msg3 repetitions as in some cases this could allow for SDT. FFS how it is configured.  |
| ZTE | Yes | Besides SDT, if network indicates “useFullResumeID” in SIB1, the inactive UEs needs to use preamble group B, and these Ues can also be benefit from Msg3 repetition if the RSRP is below the threshold.  |
| Samsung |  | Check with RAN1 |
| China Telecom | Yes | Network should be able to configure or not configure preamble group B for MSG3 repetition. |
| CATT | Yes |  |
| Huawei, HiSilicon |  | Currently we don’t see strong need to support Group B given the poor link quality. But we are okay to check with RAN1 |
| OPPO |  | Check with RAN1 first. |
| LG | No, but | Considering that Msg3 repetition is used only when the measured RSRP is below the threshold, we think that resource consuming by Msg3 repetition with group B should be considered more important factor than transmission of small amount of data. In addition, subsequent transmissions in RA-SDT is already allowed and transmission of small amount of data can be achieved without group B configuration. |
| Sharp | Yes | Group B can be used for Resume request for inactive UEs. Therefore, we support to introduce group B for CEovEnh. |
| Intel |  | Check with RAN1. |

Summary:

12 companies provide feedback, 6 companies support the proposal, 5 companies suggest to check with RAN1 first, and 1 company prefers to not support it. Based on company feedback, rapporteur suggests to ask RAN1 directly whether preamble Group B can be configured for Msg3 repetition.

**Proposal 6 [5 vs 6] Send LS to RAN1 to ask whether preamble Group B can be configured for Msg3 repetition.**

Similarly, for preamble group B, in [2], it is proposed to configure separate set of RA parameters for Msg3 repetition.

Proposal 3. If preamble group B is configured for Msg3 with repetitions, network can configure it with a separate set of ra-Msg3SizeGroupA, messagePowerOffsetGroupB, numberOfRA-PreamblesGroupA.

Companies are invited to show your views.

**Q9. If answer ‘Yes’ to Q8, do companies agree with above P3?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Qualcomm | Yes | The same argument for Q7 applies |
| Ericsson | Yes | Yes, We think this is fine, but we can discuss more. |
| ZTE | Yes | Details can be discussed further. |
| Samsung | Yes |  |
| China Telecom | Yes |  |
| CATT | Yes |  |
| Sharp | Yes |  |

Summary:

7 companies provide feedback, and they all agree with this proposal. However, this relates to the outcome of Proposal 5 & 6, so:

**Proposal 7 [7/7] If Proposal 5 is agreed and preamble group B is configured for Msg3 repetition, a separate set of RACH parameters can be configured for the preamble group B.**

On top of Q7, rapporteur thinks it worth to discuss whether network can control whether to enable Msg3 repetition for group B? For instance, if a cell is configured with preamble group B, can network enable Msg3 repetition only for preamble group A, or only for preamble group B, or both?

**Q10. If answers ‘Yes’ to Q8, for a cell configured with preamble group B, can network decide whether to enable/disable Msg3 repetition for preamble group B (e.g. only configure Msg3 repetition for preamble group A)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Qualcomm | Yes | Network should have that flexibility |
| Ericsson | FFS | We are not sure. Let us decide on the design above first. We do not see how this is aligned with what is described above. This sounds like legacy group A/B can be configured with repetitions. But we can discuss more.  |
| ZTE | Yes | The question means if legacy group A/B are configured in cell. For RACH resources associated with Msg3 repetition, can network only configure preamble group A? or only preamble group B?In our view, we prefer network to have the flexibility. |
| China Telecom | Yes | Agree with Qualcomm |
| CATT | Yes |  |
| Sharp | Yes | The gNB should have flexibility of enabling/disabling group B for msg3 repetition for reducing the number of RACH resource partitioning. |

Summary:

6 companies provide feedback, 5 companies think network should have flexibility in preamble group B configuration, 1 company is unsure and suggests to conclude the basic design first.

Since rapporteur suggests to check with RAN1 on preamble group B, this issue can be discussed in RAN1 when discussing the LS, thus proposal will not be provided.

## Msg3 repetition for specific beams

In [3], it mentions that Msg3 repetition may only be needed when UE is the coverage of partial beams. From network perspective, network can determine these ‘problematic’ beams based on MDT (e.g. RLF report). Considering RAN1 agreed to use “separate preamble with shared RO” approach for requesting Msg3 repetition, it will be a challenge for network to configure RACH resources for Msg3 repetition (because preamble resource is quite limited).

If network is able to only enable Msg3 repetition for partial beams, then network only needs to reserve RACH resources (e.g. RA preambles) for those problematic beams, more RACH resources can be reserved for other purpose.

Rapporteur understands this relates to RACH partition discussion, but it will be good if companies can confirm whether such requirement is needed. So we can provide guidance to the common session.

**Q11. Do companies think there is requirement to allow network to only enable Msg3 repetition on specific beams (e.g. in order to reduce the RACH resources reserved for CE purpose)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Lenovo |  | We were told by our RAN1 colleagues that RAN1 is discussing this topic. So, it may be good to coordinate with RAN1 on this topic. |
| Qualcomm | See comment | We can understand the intention behind the proposal. But this requires discussion on whether PRACH or RACH resources can be configured on a per-beam basis, which has much bigger scope than Msg3 repetition. Maybe it can be discussed under A.I. 8.18.  |
| Ericsson | No | We do not think that this type of optimizations are needed. Similar things were suggested for 2-step random access with similar optimization-abilities, but it was not pursued.Also agree with QC that this could be discussed within the context of RA partitioning.  |
| ZTE | Yes | We understand RA partitioning common session only discuss the solution based on the requirements received from each WI. We think in RAN2 CE session, we can confirm the feasibility. Whether it is really needed to help saving RACH resource can be further determined in the common session.  |
| Samsung | No | Follow legacy principle  |
| China Telecom | Not sure | Agree that this can be discussed and decided in the common session. |
| CATT | Perhaps not | We do not see a strong need to go away from existing framework. Also as has been pointed out this seems not part of the WID?  |
| Huawei, HiSilicon | No | Not essential |
| OPPO | No | No optimization on beam-level Msg3 repetition unless requested by RAN1. |
| LG | Yes | We agree with the intention. |
| Sharp |  | We think it relates to RACH partitioning.  |
| Intel | No | This is an optimisation in our view and if anything is needed, it should come from RAN1. We also do not think this should be discussed as part of the common RA since individual WI should decide first on whether it is needed |

Summary:

12 companies provide feedback, 2 companies think beam specific Msg3 repetition can be considered, 1 company indicates RAN1 is discussing this. 6 companies object to the proposal, and 3 companies think this can be discussed under RACH partitioning in common session.

Considering no consensus can be reached, rapporteur suggests not to provide proposal on this. Interested companies can submit paper to common session if needed.

## Way to indicate the number of Msg3 repetitions

In [4], it further discusses the solutions for indicating the number of Msg3 repetitions in Msg2.

* Option 1: Using an information field from the existing information fields in RAR UL grant;
* Option 2: Using MAC RAR for indication

Above two options are provided by RAN1, and Option 1 has already been agreed in RAN1, so this paper proposes to discuss Option 2 in RAN2, and suggest not to consider it because extend/reuse existing RAR MAC CE is not straightforward and defining a new MAC CE requires more discussion and specification effort in RAN2.

Proposal 1: No enhancements on MAC RAR are needed for MSG3 repetition.

Rapporteur notices that RAN1 is only discussing the details of Option 1 at recent meetings. So it seems Option 2 will not considered. But it would be good to confirm company’s understandings.

**Q12. Do companies agree there is no need to enhance MAC RAR for Msg3 repetition (i.e. only Option 1 is used to indicate the number of Msg3 repetitions)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Lenovo | Yes | We were told by our RAN1 colleagues that RAN1 agreed on Option 1 as Working Assumption. Further details of Option 1 are under discussion and subject to downselection (either use the MCS field or TPC field or TDRA field). Due to this we see no reason to introduce another option from RAN2 side. |
| Qualcomm | Agree | We don’t see any reasons why Option 1, which is already agreed by RAN1, is not good enough and RAN2 need to study other enhancements. |
| Ericsson  | NA | RAN1 is currently working on this and it would be better to have them decide. We propose that we do not make any agreements on this in order not to interfere with their work.  |
| ZTE | Yes | Although RAN1 marked Option 2 as FFS, we think the common understanding in RAN1 right now is that Option 2 will not be considered.  |
| Samsung | Yes |  |
| China Telecom | Yes |  |
| CATT | Yes |  |
| Huawei, HiSilicon | Yes |  |
| OPPO | Yes |  |
| LG | Yes | Option 1 is already a working assumption in RAN1. |
| Sharp | Yes | RAN1 agreement is to reuse one information field in RAR UL grant. |
| Intel | Yes |  |

Summary:

12 companies provide feedback, 11 company think MAC RAR based approach is not supported, 1 company thinks RAN1 is discussing this and will make a decision.

After checking with RAN1 offline, seems RAN1 has no plan to discuss this (at least in this meeting). Based on the significant support from companies, rapporteur thinks it is mature to make a decision in RAN2 and there is very low risk that RAN1 will make opposite decision.

**Proposal 8 [11/12] RAN2 confirms using MAC RAR for indicating MSG3 repetition is not supported.**

## UE capability

Regarding UE capability of Msg3 repetition, in [2], it proposes to not introduce UE capability, because PRACH resource for requesting Msg3 repetition is signalled in system information. If network wants to know the percentage of UE’s capability, other methods can be used. E.g. RACH report via MDT.

Rapporteur thinks this makes sense for initial access UEs, but we also need to consider other RACH events (e.g. handover, BFR) which UE is in RRC\_CONNECTED mode. Note that for BFR, network can configure separate RACH resource in BFR configuration, and for handover to non-initial BWP in target cell, the common RACH resource (for CBRA) is provided via RRC dedicated signalling.

**Q13. Do companies agree there is no need to introduce UE capability for Msg3 repetition?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Lenovo | Postpone | We should wait for RAN1 progress. RAN1 is discussing whether the UE capability of supporting Msg3 PUSCH repetition needs to be reported after initial access procedure or not. |
| Qualcomm | Yes | All RACH enhancements for RRC Idle/Inactive are optional features, not UE capabilities.For RRC Connected, because Msg3 repetition is for CBRA only, RACH resources for Msg3 repetition are configured by common signaling. So network does not need to know whether UE supports msg3 repetition or not.  |
| Ericsson | No  | We just do not see a reason why we wouldn’t introduce a capability bit for it. One reason is related to connected mode configuration. Other reason is the problem of relying on SON or RACH report for an indication of msg3 repetition support is two-fold: 1) this requires the UE to also implement SON features, and 2) SON will not address msg3 repetitions in Rel-17 as far as I know. |
| ZTE | No | For BFR with CBRA, the RACH resource can be configured in dedicated signalling (e.g. BeamFailureRecoveryConfig), without UE capability, then network has to configure Msg3 repetition blindly in dedicated signalling, and non-Msg3 repetition capable Ues are required to ignore those fields. However, since there may be other capability introduced for indicating the support of PUSCH/PUCCH repetition, probably no separate capability is needed for Msg3 repetition, we are fine to postpone the discussion after knowing the overall capability design for Rel-17 CE.  |
| Samsung | Postpone | Wait for RAN1 progress |
| China Telecom | No | Even though a UE is capable of MSG3 repetition, it would not request MSG3 repetition unless the RSRP threshold is fulfilled. In some RACH cases for RRC\_CONNECTED UE, the UE capability information for MSG3 repetition would be helpful.According to the current R16 SON/MDT feature and R17 SON/MDT scope, coverage enhancement related SON/MDT is not supported, i.e. the RA report/RLF report/CEF report would not indicate whether MSG3 repetition happens in RA or whether the UE support MSG3 repetition if MSG3 repetition does not happen in RA. |
| CATT | Seem comments | We are OK to discuss this later. But technically, there seems to be no need to introduce UE capability for MSG3 ‎repetition. Firstly ‎the UE can indicate the network via preamble or RO (if ‎agreed by RAN1), according to NW configuration of RACH resource. Then the other reason is that the network ‎cannot obtain the UE capability at the stage of Msg3 tx for initial access or other cases.‎ |
| Huawei, HiSilicon | Too early | We think it is too early to discuss UE signalling without fully understanding the basic procedures. Keep in mind that 2-step RA introduced the UE capability signalling, which is introduced by RAN1. |
| OPPO | Postpone |  |
| LG | Postpone | Wait for RAN1 progress |
| Sharp | No | Agree with ZTE. For BFR with CBRA, dedicated signalling is to be used for configuring the RACH resource. Ehen the capability signalling is not supported, the gNB cannot configure the dedicated configuration. |
| Intel | Postpone | It might be better to postpone UE capabilities related discussion as this is the first meeting to discuss the WI in RAN2. |

Summary:

12 companies provide feedback, 1 company thinks explicit capability is not needed, 1 company did not provide clear answer, but the comment shows the preference of not having capability. 4 companies think capability can be helpful, 6 companies suggest to postpone the discussion.

Considering we usually discusses UE capability after finalizing the technical details of mechanism, so it is fine to postpone, and perhaps RAN1 can provide more inputs on UE capability design.

**Proposal 9 Postpone the discussion on UE capability (i.e. whether explicit UE capability is needed for indicating the support of Msg3 repetition).**

# Conclusions

*All proposals in ascending order.*

**Proposal 1 [9/12] Send LS to RAN1 to ask:**

* **Q1: whether Msg3 repetition can be supported on both NUL and SUL?**
* **Q2: If answer ‘Yes’ to Q1, whether different RSRP thresholds are needed for NUL and SUL?**

**Proposal 2 [4 vs 6] To discuss whether network can configure a separate set of minimum cell access thresholds (e.g. Qrxlevmin, Qqualmin) for Msg3 repetition capable UEs.**

**Proposal 3 (To discuss) For starting/re-starting *ra-ContentionResolutionTimer* in Msg3 repetition, to select one of following options:**

* **Option 1[5]: (Re)start *ra-ContentionResolutionTimer* in the first symbol after all Msg3 repetitions;**
* **Option 2[3]: (Re)start *ra-ContentionResolutionTimer* in the first symbol after each Msg3 repetition.**

**Proposal 4 [11/12] Extension of *ra-ResponseWindow* and *ra-ContentionResolutionTimer* are not needed for Msg3 repetition.**

**Proposal 5 [5 vs 6] (To discuss) Msg1 transmission by UE to request Msg3 repetitions can be configured with its specific set of RACH parameters (e.g. preambleReceivedTargetPower, powerRampingStep, powerRampingStepHighPriority, preambleTransMax, groupBconfigured).**

**Proposal 6 [5 vs 6] Send LS to RAN1 to ask whether preamble Group B can be configured for Msg3 repetition.**

**Proposal 7 [7/7] If Proposal 5 is agreed and preamble group B is configured for Msg3 repetition, a separate set of RACH parameters can be configured for the preamble group B.**

**Proposal 8 [11/12] RAN2 confirms using MAC RAR for indicating MSG3 repetition is not supported.**

**Proposal 9 Postpone the discussion on UE capability (i.e. whether explicit UE capability is needed for indicating the support of Msg3 repetition).**

*Reordering of proposals for online discussion.*

For easy agreements:

**Proposal 1 [9/12] Send LS to RAN1 to ask:**

* **Q1: whether Msg3 repetition can be supported on both NUL and SUL?**
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For further discussion:

**Proposal 2 [4 vs 6] (To discuss) Network can configure a separate set of minimum cell access thresholds (e.g. Qrxlevmin, Qqualmin) for Msg3 repetition capable UEs.**

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**Proposal 6 [5 vs 6] Send LS to RAN1 to ask whether preamble Group B can be configured for Msg3 repetition.**

# References

1. R2-2107008 MAC Aspects of UL Coverage Enhancements Samsung Electronics Co., Ltd discussion Rel-17 NR\_cov\_enh-Core
2. R2-2107220 RAN2 enhancements for Msg3 repetition Qualcomm Incorporated discussion Rel-17 NR\_cov\_enh-Core
3. R2-2107745 Consideration on Msg3 repetition in CE ZTE Corporation, Sanechips discussion Rel-17 NR\_cov\_enh-Core
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